



# Rapid Mortality Monitoring during heatwaves

**Nick Andrews**  
**Centre For Infections, HPA**  
**July 2010**

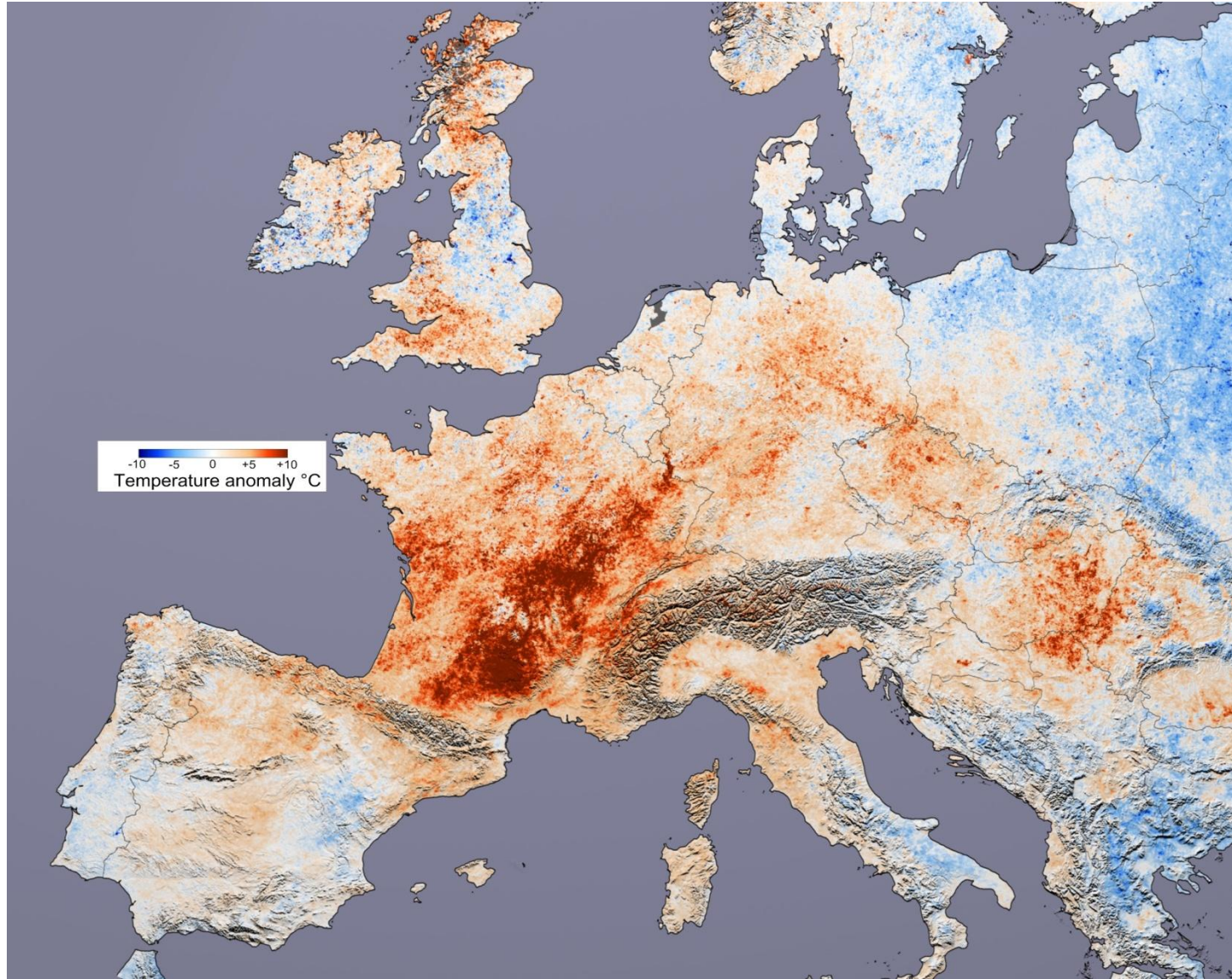


# Outline

- Heatwaves
- Mortality data-flow - estimating current mortality
- Setting baselines and limits – expected mortality
- The 2009 Heatwave
- Comments & future plans

# Introduction

## The 2003 Heatwave



# 2003 Heatwave



- Record UK temperature of 38.5c (101.3 f)
- 45,000 excess deaths in Europe in August 2003 (2,000 in UK, 15,000 France) when comparing to summers before and after\*
- Also evidence Ozone pollution played a role – but hard to separate from temperature.
- Many countries made Heatwave plans

\*[http://ec.europa.eu/health/ph\\_information/dissemination/unexpected/unexpected\\_1\\_en.htm](http://ec.europa.eu/health/ph_information/dissemination/unexpected/unexpected_1_en.htm)

# heatwave PLAN FOR ENGLAND



PROTECTING HEALTH AND  
REDUCING HARM FROM  
EXTREME HEAT AND HEATWAVES



# The Heatwave Plan for England

- Heatwaves set to become more common
- Short term plans
  - Identify vulnerable populations
  - Moving patients in hospitals
  - Identify vulnerable infrastructure (food storage/computer servers..)
  - Providing information / advice to public
- Long terms plans
  - building homes / hospitals,
  - Transport
- Alert levels
  1. All summer
  2. 60% chance of heatwave within 2-3 days
  3. Heatwave thresholds reached
  4. heatwave for 4 or more days in 2 or more regions

# Main health effects of heat

- Respiratory disease (pollution)
- Cardiovascular disease (extra blood needs to be circulated to the skin to keep cool – strain on the heart)
- Both of these can lead to death

# Heatwave definition

Region	Max Day	Min Night
London	32	18
South East	31	16
South West	30	15
Eastern	30	15
West Mids	30	15
East Mids	30	15
Y&H	29	15
North East	28	15



# The 2009 Heatwave

Region	Threshold		Jun 29		Jun 30		Jul 01		Jul 02		Jul 03	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
London	18	32	19	31	18	31	17	31	16	31	20	26
SE England	16	31	18	32	18	34	19	33	16	33	19	26
SW England	15	30	17	29	18	28	18	31	17	30	17	25
E England	15	30	19	29	16	29	17	29	14	29	17	27
E Midlands	15	30	16	28	15	29	18	29	17	29	16	25
W Midlands	15	30	17	29	18	29	20	30	18	29	18	25
Yorkshire & Humberside	15	29	16	25	15	28	18	29	18	28	15	22
Wales	15	30	17	28	17	27	18	29	19	29	17	26
NW England	15	30	18	28	19	27	20	29	22	29	19	23
NE England	15	28	15	22	14	25	18	27	17	26	14	21

? What was the impact on Mortality

# Rapid Mortality Monitoring

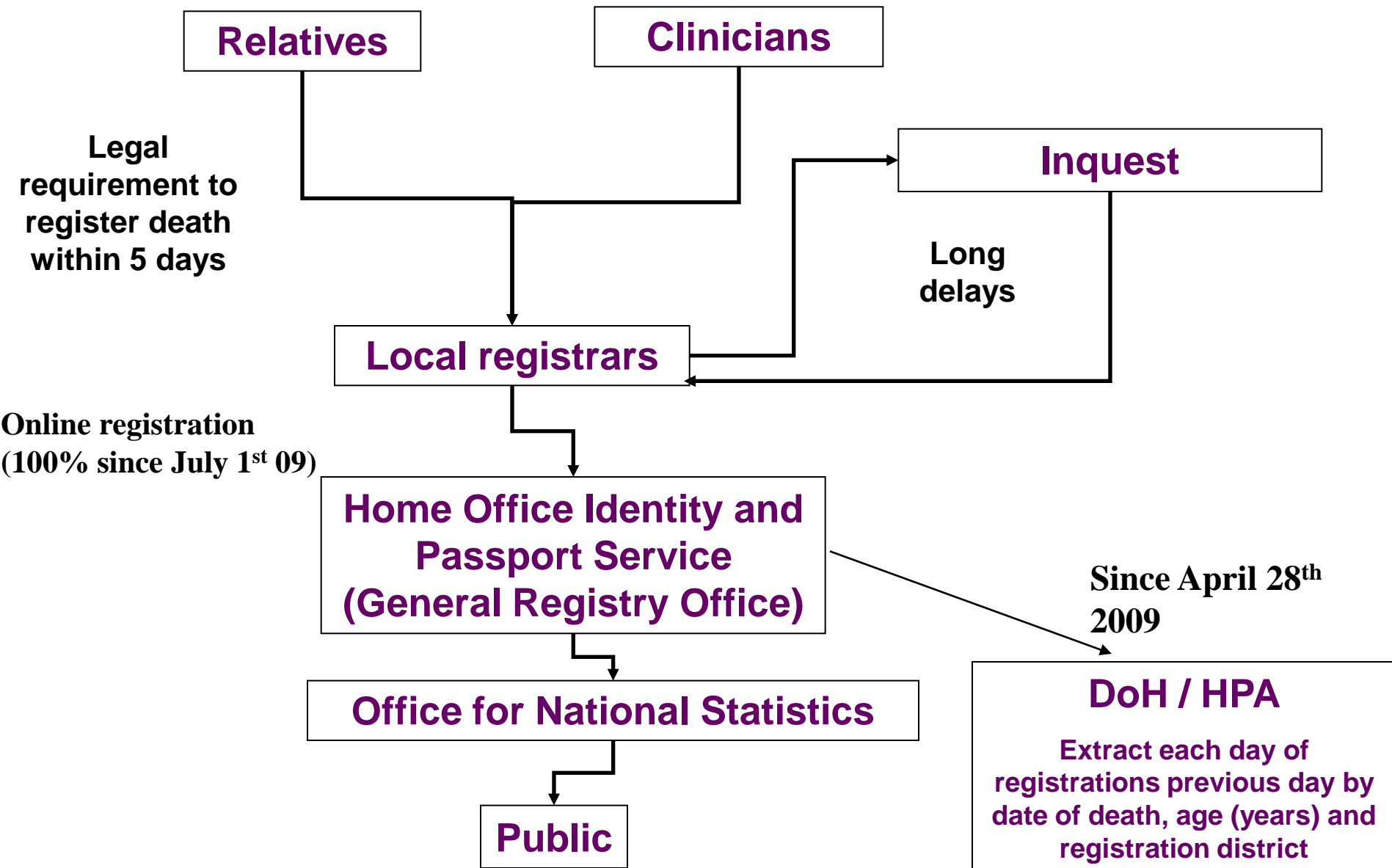
- Enable rapid assessment of the impact of a heatwave
- Enable assessment of the effect of interventions

# Excess mortality

- Expected deaths for that time of year under ‘normal conditions’
- Actual deaths for the days of the heatwave
- $\text{Excess} = \text{Actual} - \text{Expected}$
- Simple?

Estimating the number of deaths that  
have occurred (Actual deaths)

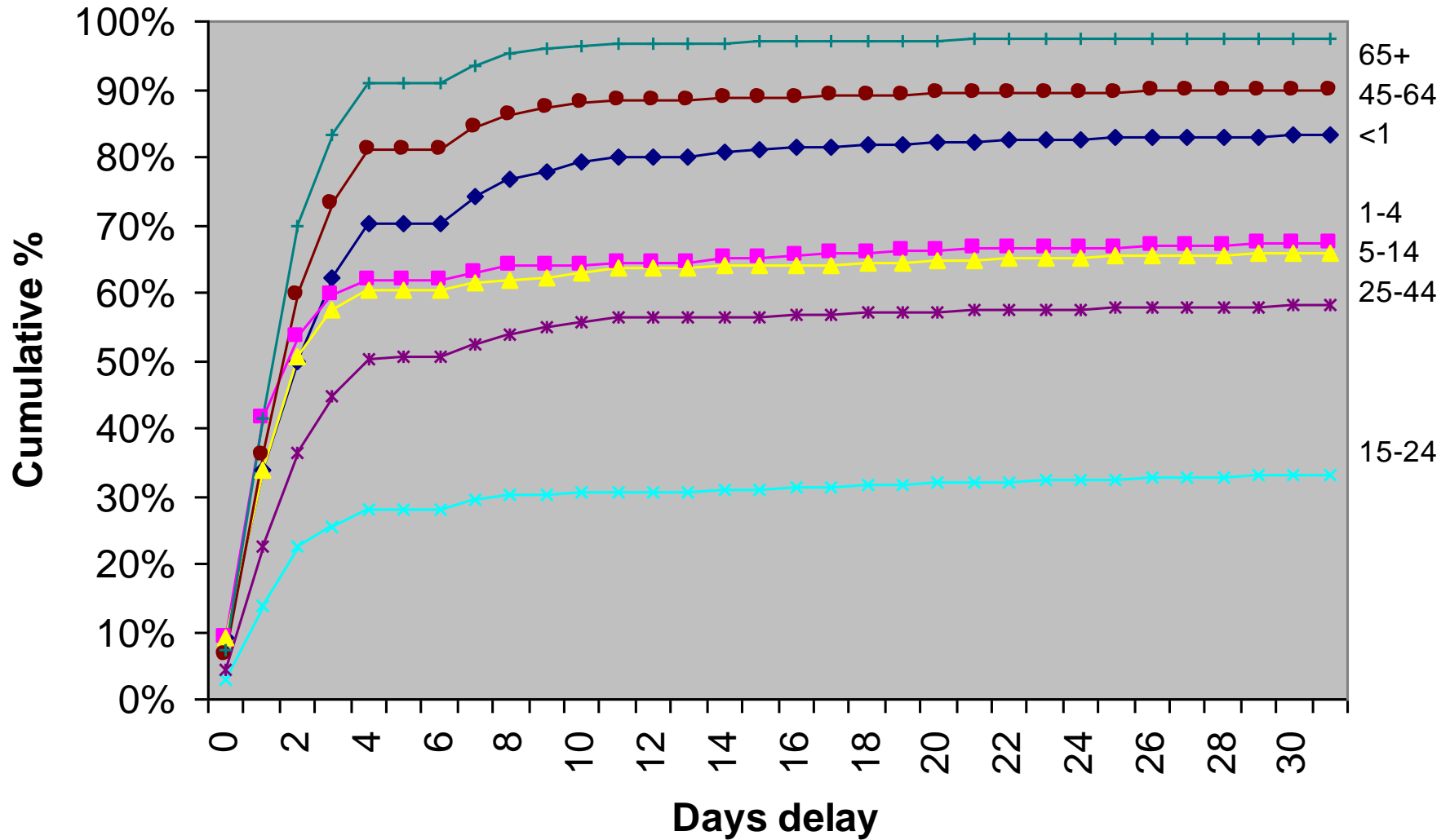
# Deaths registrations in E & W – data flow



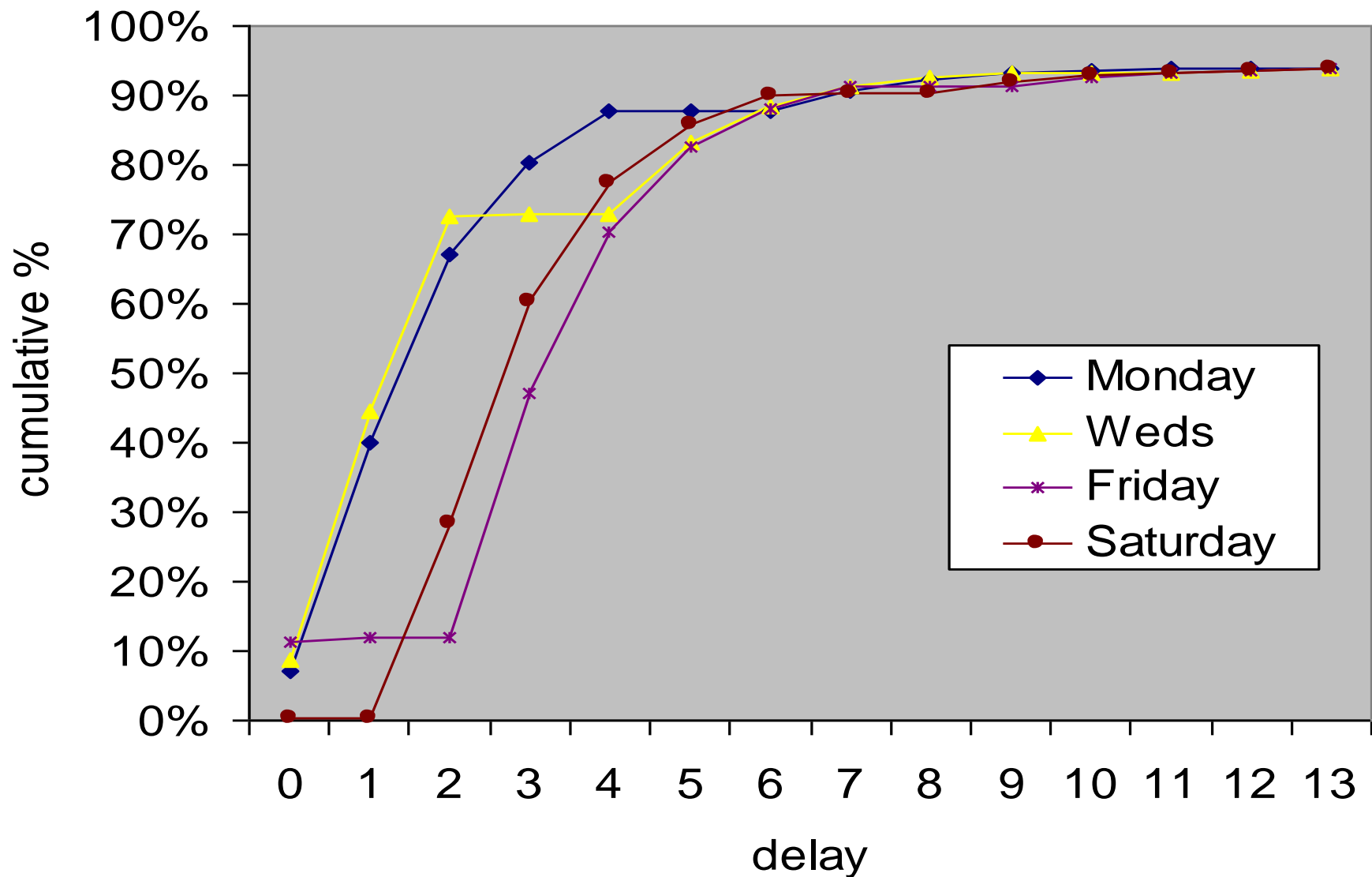
# Delay from death to registration

- Delays vary greatly by age
- In the short term they also depend on the day of the week of death (weekend effect) and holidays.
- No sensible estimate for a given day is possible for at least 3 working days.
- Deaths either get reported within about 10 days or they fall into a group that can takes many months (coroner's inquests).

# Delays by age within the first month



# Delays by day of the week





# Correcting for delays

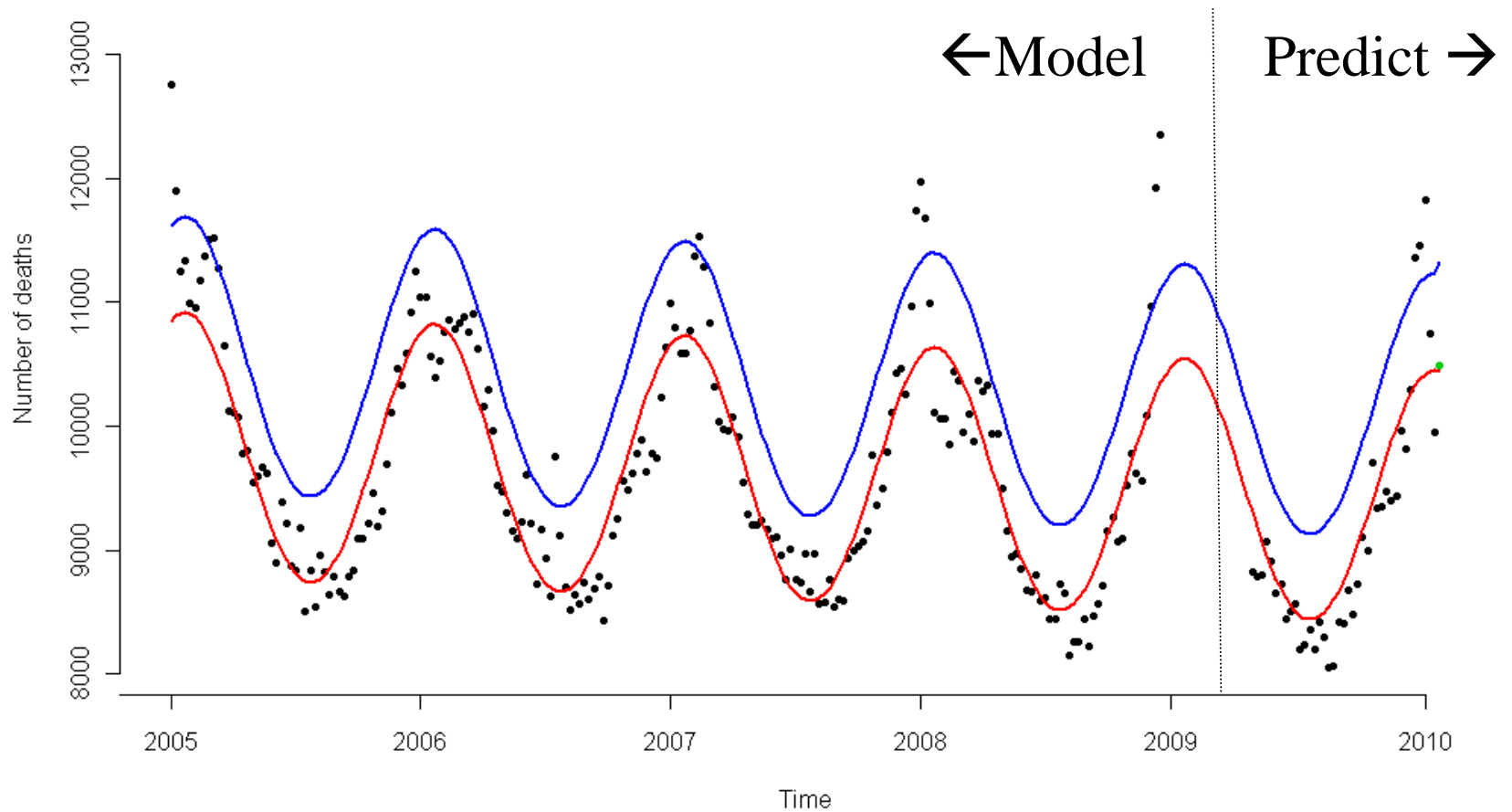
- Suppose from past data we know that 80% of deaths in those aged 65+ that happen on a Friday are registered by the next Wednesday.
- Then if we have observed 1000 deaths by Wednesdays we estimate a final total of  $1000/0.8=1250$ .
- In a similar way we corrected deaths from April 28<sup>th</sup> 2009-June 30<sup>th</sup> 2009 by the estimate of the proportion of deaths reported online.

# Expected Deaths

- Use daily data from 1999-2008 for England and Wales by age/region (ONS data)
- Fit a statistical model (Serfling).
  - Poisson regression model, rescaled for over-dispersion and refitted twice with outliers down weighted to reduce the effect of previous excesses (e.g. influenza epidemics).
- An upper prediction limit is added

# Baseline for all deaths (weekly model)

All ages 2005-present



# The heatwave of June 30<sup>th</sup> – July 2<sup>nd</sup> 2009

- What we did at the time
- Retrospective analysis
- Regional analysis

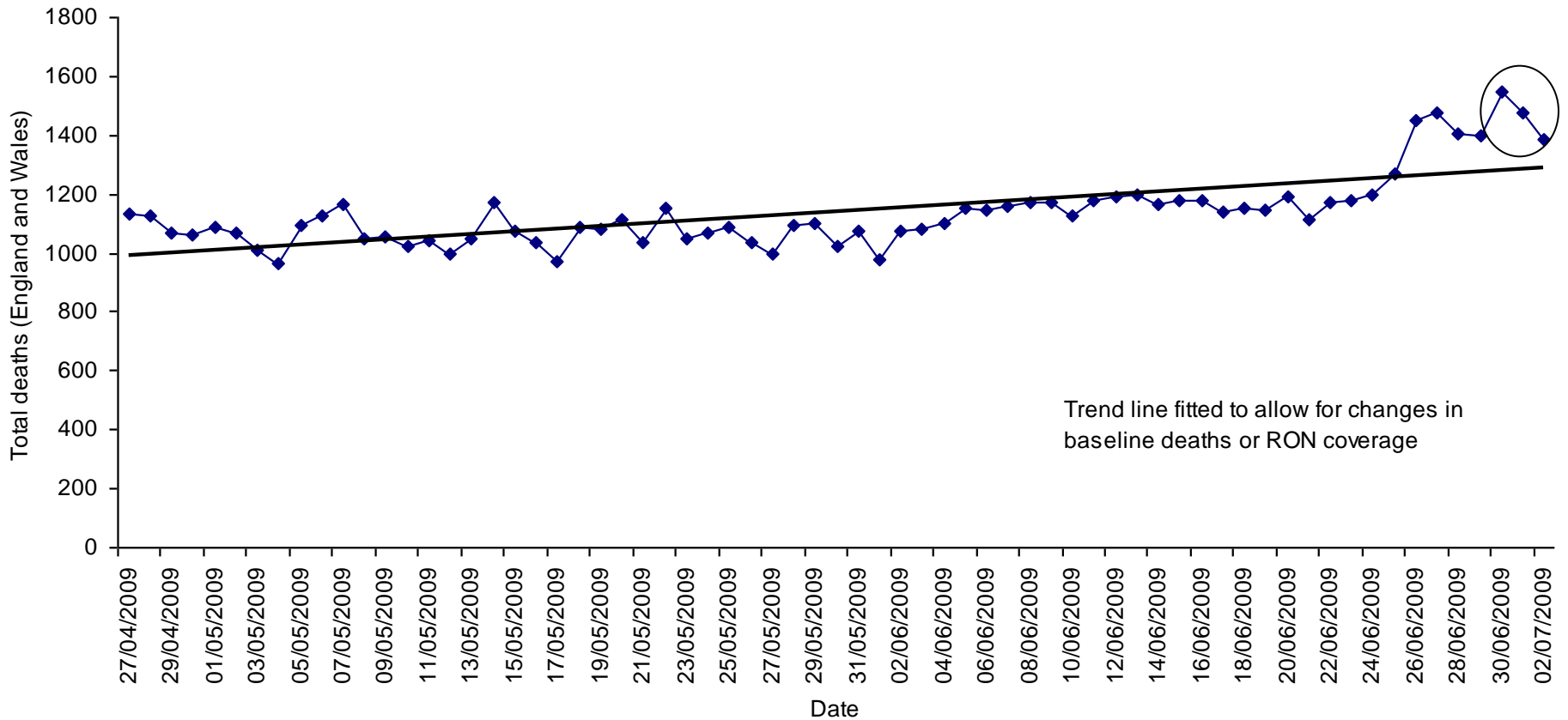
# What we did at the time

- July 1<sup>st</sup> and 2<sup>nd</sup> (Thursday/Friday) 2009 heatwave alert
- On July 6<sup>th</sup> we did an analysis using all registrations reported by July 5<sup>th</sup> (the Monday)
- This appeared to show an excess

# Apparent Excess late June/ early July 2009

trend line is fitted to observed data

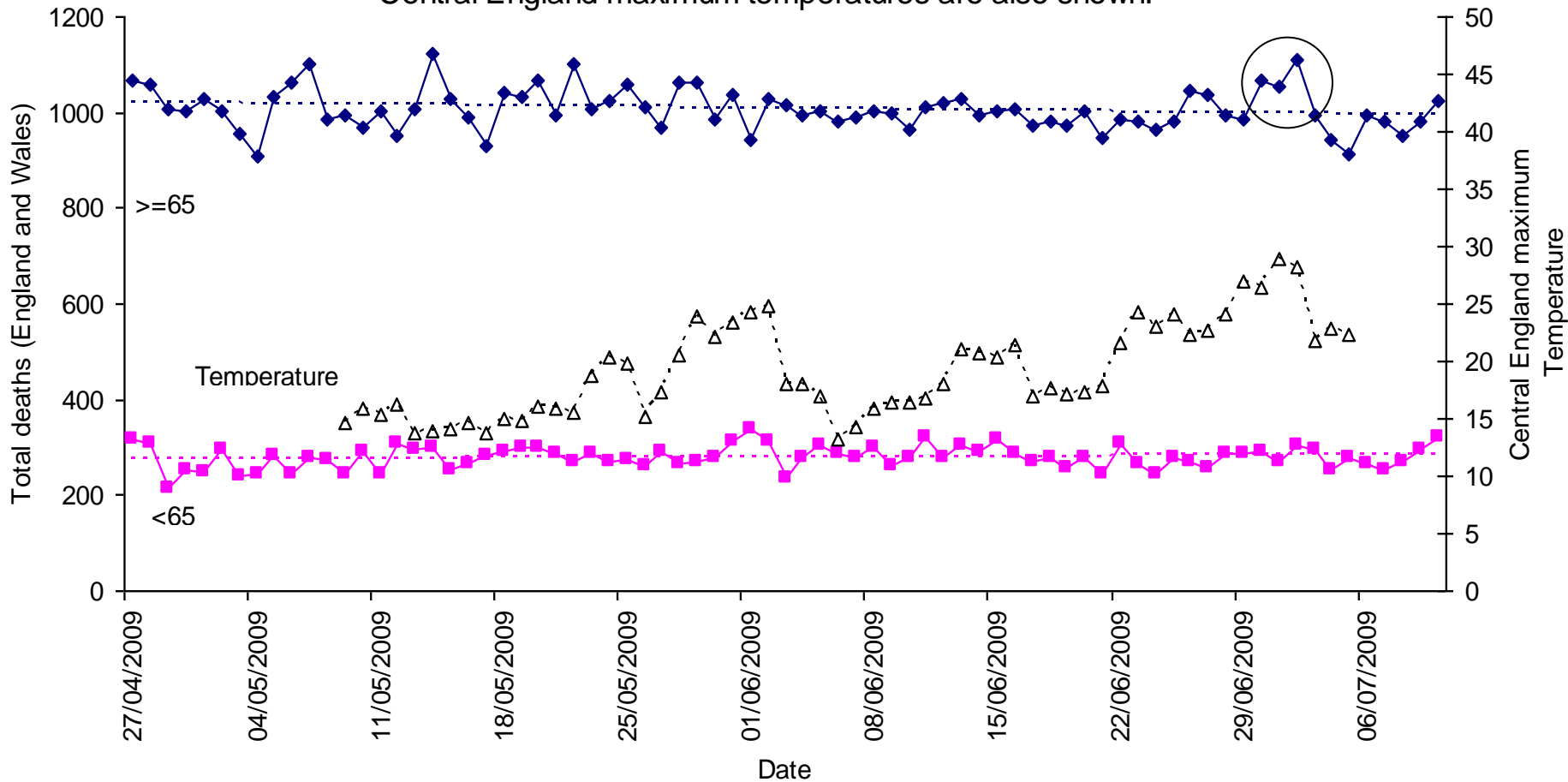
RON deaths in over 65s by date of death with correction for reporting delay and RON coverage using registrations to July 5th 2009



# Apparent Excess late June/ early July 2009

- At that time we did not know whether all registry offices were reporting.
- We knew the number reporting was increasing and this could explain the recent rise.
- A few days later we were told reporting had increased from 80% to 100% on July 1<sup>st</sup> !!
- We corrected for this and things looked quite different!

Figure2: RON deaths in over 65s and under 65s by date of death with correction for reporting delay and RON coverage using registrations to July 13th 2009.  
 Central England maximum temperatures are also shown.

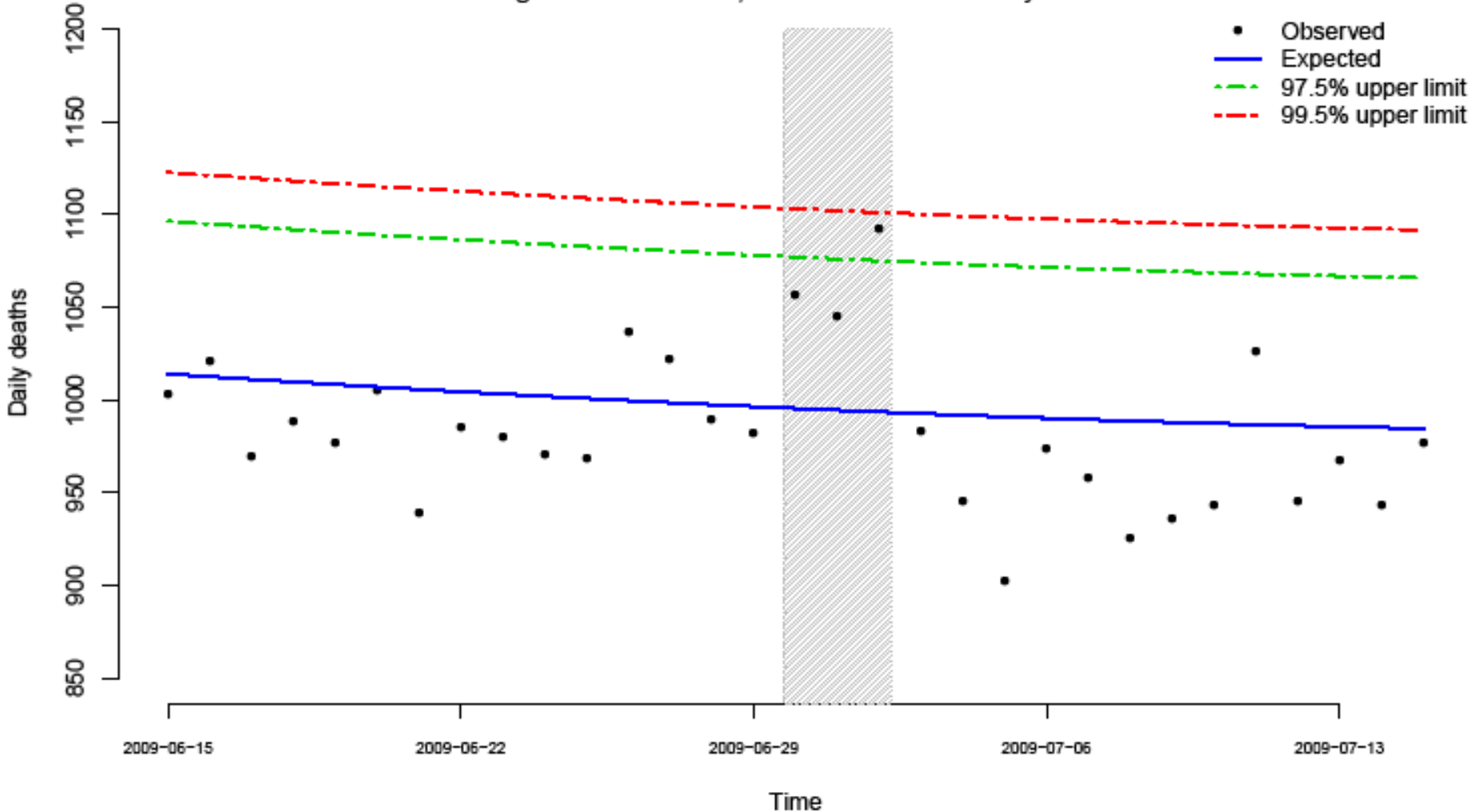


Excess June 30th to July 2<sup>nd</sup> = 246



# Final Model using data to the end of March 2010 and expected from historical model

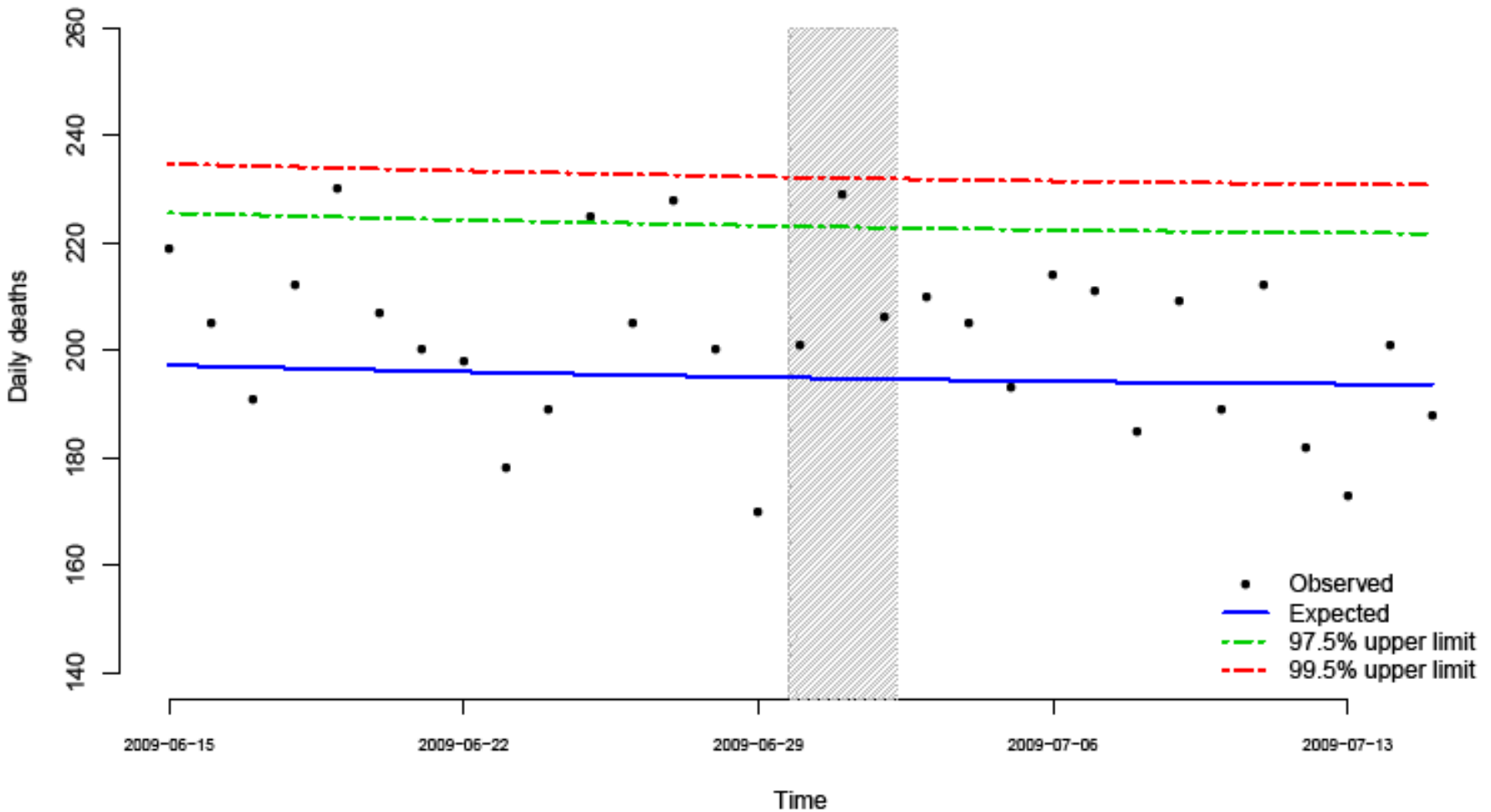
**Observed and expected mortality in persons aged 65+ years**  
England and Wales, 15th June – 15th July 2009



Excess June 30th – July 2<sup>nd</sup> approx 200 - 300

# AGE 65-74

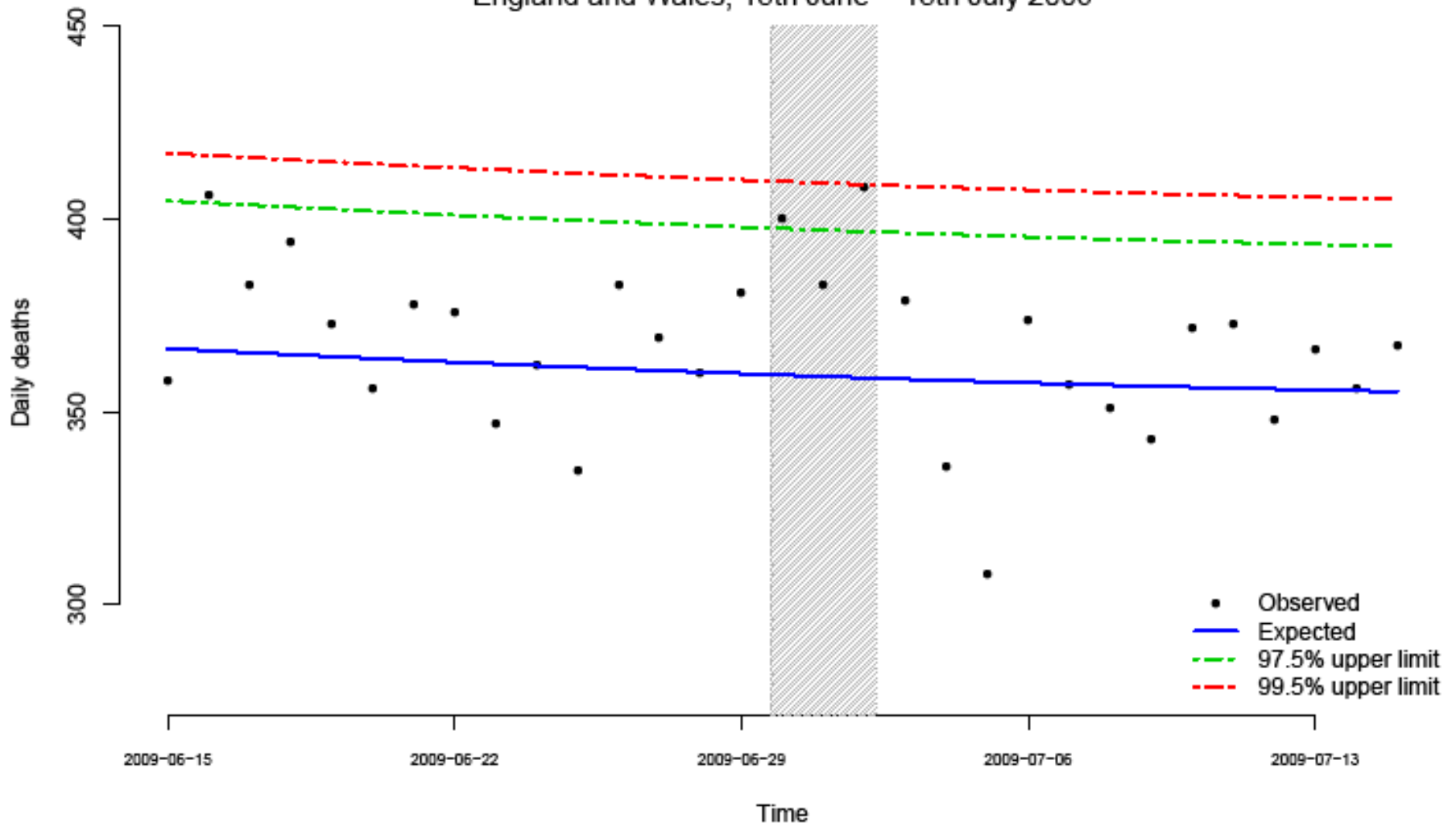
Observed and expected mortality in persons aged 65to74 years  
England and Wales, 15th June – 15th July 2009



# AGE 75-84

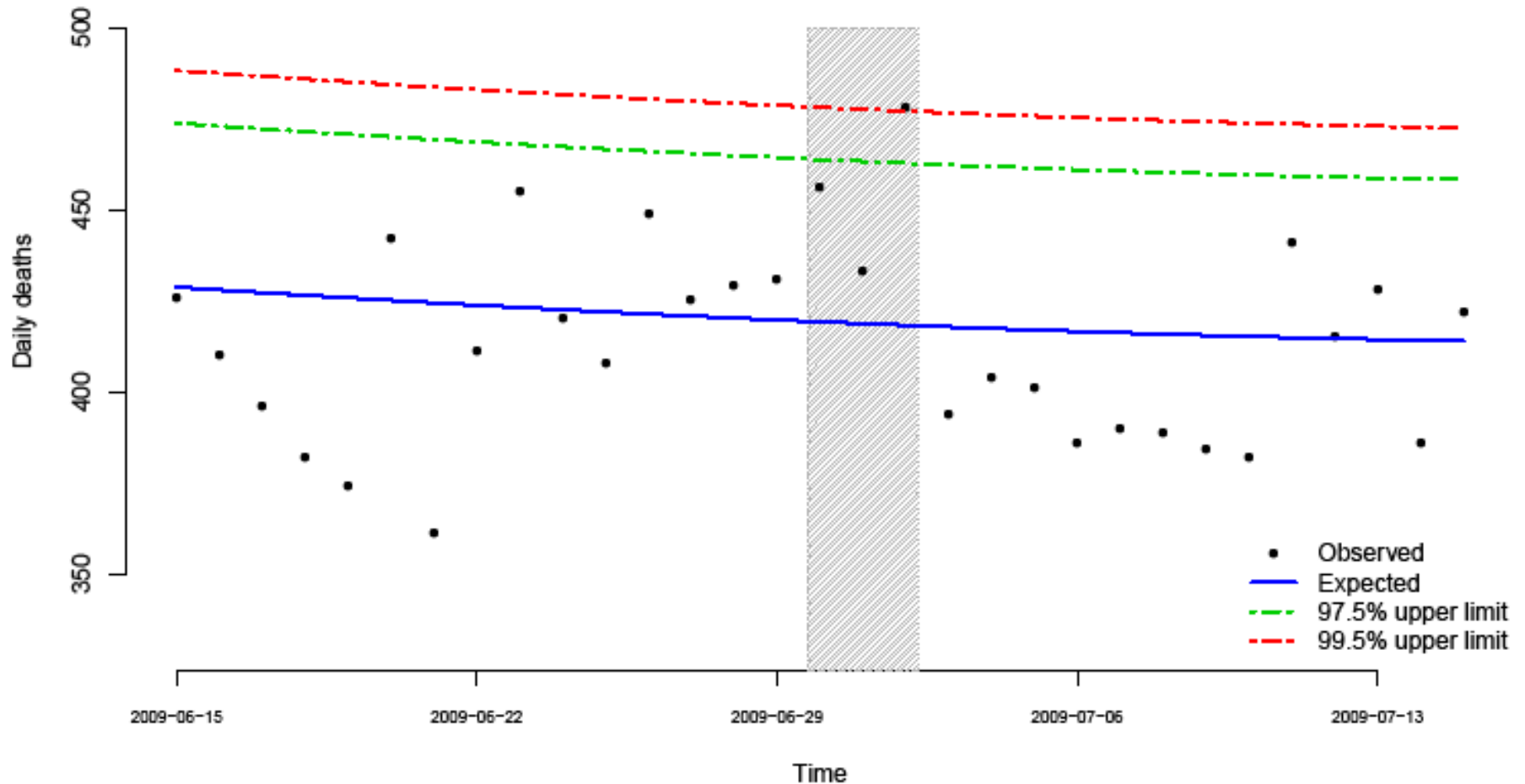
## Observed and expected mortality in persons aged 75to84 years

England and Wales, 15th June – 15th July 2009



# AGE 85+

**Observed and expected mortality in persons aged 85+ years**  
England and Wales, 15th June – 15th July 2009



# Comments on the heatwave

- About 200 -300 excess deaths in the heatwave
- The estimated 1093 deaths in those aged 65+ on July 2<sup>nd</sup> 2009 was the highest number for any day between June 1<sup>st</sup> and August 30<sup>th</sup>
- The estimate made shortly after the heatwave remained similar to current update.
- Seemed to effect the 75+ most
- A small decline the few days after but not enough numbers to determine a harvesting effect.
- Unlikely to be due to Pandemic Flu as this was at very low levels in the Elderly at this time and did not show clear excess mortality in any age group through the pandemic

# Future plans

- Daily data flow has stopped
- If a heatwave is forecast it will restart
- We are working on regional models –  
(excess was too small in 2009 to see a clear regional pattern)
- Establish continuous data flow for heat / cold/ influenza and Olympics 2012.

# Acknowledgements

- Pia Hardelid (centre for infections)
- Richard Pebody (centre for infections)
- Graham Bickler (London region)
- Sandra Johnson (London region)
- Virginia Murray (Chemical hazards + Poisons)
- Office for National Statistics, General Registry Office, Met Office